

# EXHIBIT 1

## Jaswinder Pal Singh

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### EDUCATION

Stanford University. Ph.D. in Electrical Engineering, 1993.

Stanford University. M.S. in Electrical Engineering, 1989.

Princeton University. B.S. in Electrical Engineering and Computer Science, 1987, *summa cum laude*.

### PROFESSIONAL EXPERIENCE

- 7/05 – present     *Professor of Computer Science, Technology and Societal Change*, Princeton University. *Professor*, Computer Science Department.
- 3/22 – present     *Director*, Princeton DeCenter (Princeton Center for the Decentralization of Power through Technology), a university-wide interdisciplinary center.
- 9/19 – 6/21        *Director of Undergraduate Studies* (Majors), Computer Science Department, Princeton University.
- 10/13 – present   *Chairman of the Board of Directors*, 8x8 Inc. (NASDAQ:EGHT).
- 7/22 – present     *Member of the Board of Directors*, Clearwater Analytics Holdings, Inc. (NYSE:CWAN).
- 1/19 – present     *Member of the Board of Directors*, Hiro, Inc. A private company in blockchain technology.
- 7/03 – present     *Executive Committee*, Princeton Institute for Computational Science and Engineering (PICSSiE). A permanent institute we created from the PICASso program that I led, and that has taken over its activities, including a permanent Graduate Certificate Program in Computational Science and Engineering at Princeton I developed. The Certificate Program is approved by the Graduate School as a formal credential appearing on students' records.
- 2011 – present     *Co-founder*, CaaStle. A technology and logistics company that seeks to transform a highly inefficient apparel industry through technology and data, operating a white-label platform for companies to run subscription-based and other rental services for clothes.
- 2022 – present     *Co-founder*, Trust Machines. A technology company in the blockchain space.
- 9/14 – 7/20        *Member of the Board of Trustees*, The Dalton School, New York.
- 7/14 – 2022        *Director*, Program in Applications of Computing, Princeton University. A program for about 125 non-Computer Science majors.
- 9/99 – 2010        *Director*, Program in Integrative Computer and Application Sciences (PICASso), a multi-department, university-wide interdisciplinary program at the boundary of computer science and a broad range of application disciplines. Developing and fostering new interdisciplinary courses, practice-oriented workshops in scalable computing, interdisciplinary seminar series, and programs in written and oral scientific communication, as well as funding graduate students in different departments and running the program. Seeding PICSciE Institute and university-credentialed Graduate Certificate Program.
- 9/05 – 9/07        *Director*, Princeton portion of Center for Modeling Viral Immunity and Antagonism, a \$20+M NIH Center involving Mount Sinai School of Medicine and Princeton. Member, Executive Committee.
- 9/00 – 6/05        *Co-founder and Chief Technical Officer*, firstRain, Inc. (on leave from Princeton University 9/00 to 6/02). Developing novel Internet/Web applications and Internet infrastructure. Improved and developed new protocols for web-based communication and information access.
- 7/99 – 6/05        *Associate Professor*, Computer Science Department, Princeton University. Teaching, and performing research in scalable computer systems and applications.
- 3/99 – present     *Member, Technical Advisory Board*, U.S. Govt. NOAA Geophysical Fluid Dynamics Laboratory. Aiding in shift from vector to parallel computing and procurement of large computing and analysis infrastructures.

- 2/95 – 6/99      *Assistant Professor*, Computer Science Department, Princeton University. Teaching, and performing research in scalable computer systems and applications.
- 2/93 - 1/95      *Research Associate*, Stanford University. Leading the parallel applications effort in the Stanford DASH/FLASH research groups and studying the implications of these applications for the design of multiprocessor software and hardware systems. Expanding the SPLASH suite of parallel applications that I developed and distributed to the community to SPLASH-2. Advising several Ph.D. students.
- 10/87 – 2/93      *Research Assistant*, Stanford University. Developing parallel scientific and engineering applications and studying their implications for parallel systems, software, and architecture. Studying the scaling of applications and architectures. Creating and distributing the SPLASH suite of parallel applications.

## HONORS

- Endowed Chair Professorship at Princeton University.
- *Presidential Early Career Award for Scientists and Engineers (PECASE)*, 1997. Awarded to 20 young scientists and engineers in the United States selected from all areas of science/engineering by the National Science Foundation.
- *Sloan Research Fellowship*, 1997. Awarded to about 10 young computer scientists every year.
- Paper selected as DEBS 2005 Most Influential Paper. May 2019.
- Paper selected as Best Student Paper in USENIX USITS Symposium, 2000.
- Paper selected for journal publication from the International Conference on Supercomputing, 1999.
- Paper selected for Journal of Computational Biology from the RECOMB computational biology conference, 1998.
- Paper selected for journal publication from the Symposium on Parallel Algorithms and Architectures, 1996.
- Paper selected for journal publication from the Symposium on Parallel Algorithms and Architectures, 1996.
- Paper nominated for Best Student Paper Award for Supercomputing'97.
- Two papers selected among best 5 submitted to the Intl. Symposium on Computer Architecture (1992 and 1993), one of them as “Impact Paper” for the Federated Computer Research Conferences, 1993.
- *Summa cum laude*, Princeton University. Princeton University Undergraduate Scholarship.
- Member of Phi Beta Kappa, Tau Beta Pi, and Sigma Xi since 1987.

## TEACHING

Created several new courses at Princeton, including requirement-satisfying undergraduate courses and graduate-level courses. Consistently taught undergraduate courses for last many years, including new courses and core/service courses. The former includes COS 448: Innovating at the Boundary of Technology and Business and COS 471: Decentralization, Blockchains and Applications, that both started experimentally but became core curricular courses. Graduate courses created include Internet services, applications, protocols, and infrastructure, as well as in scalable distributed and parallel computing and analysis of data. Created and taught several new interdisciplinary courses, catering to and attracting students from many different departments on campus, from Sciences, Engineering, Social Sciences and Humanities.

- Fall 22, Spr 23      COS 471: Decentralization, Blockchains, Cryptocurrencies, and Web3: Undergraduate course across blockchain technology, systems, applications, and governance. #2 among all Princeton courses in “notifications-awaiting” service in 2022: Reached enrolment cap with seniors alone within two minutes of being open, with a long waitlist.
- S’11-21, F’22      COS 448: Innovating at the Boundary of Technology, Business and Marketplaces (dubbed the “CTO Course”). Reached enrolment cap about every year during Junior/Senior enrolment, with waitlist. New course to train students to innovate at the boundary of technology, business, and society by understanding all sides, and to become highly effective “Chief Technology Officers” in the future by becoming true partners to Chief Executive Officers and organization leadership.
- Fall 14-21      COS 318: Operating Systems. Junior course in the design and development of operating systems, including a project to build an operating system from scratch.
- Fall 09-13      COS 217: Introduction to Programming Systems. Sophomore core course in structured and systems programming, with growing enrollments.

Fall 08-09	COS 318: Operating Systems. (Fall'09 is counted twice because stepped in to co-teach 318 along with teaching COS 217 due to department need.)
Spring 10	Economic & Systems Design for Electronic Marketplaces. A new course designed to teach marketplace design in an interdisciplinary fashion, at the boundary of economics, computer science and the applications of marketplaces. Topics ranged from game theory to scalability to online advertising, marketplace design principles and market mechanisms.
Spring 09	General Computer Science (COS 126). Faculty preceptor in introductory CS course.
Spring 07-08	Parallel Computer Architecture and Programming. Graduate course I developed.
S'03, 05, F' 06	Computers and Computing. A broad introduction to Computer Science for students who are not intending to major in Computer Science.
Spring 06	Dynamic Simulation and Data Analysis Methods for Science and Engineering. A new, interdisciplinary Graduate course offered under the PICASSo program, designed to expose students from departments across the university to a range of computational methods for analysis of data and integration with dynamic simulation models, their use in real applications, and scalable parallel computing for them. Team-taught by faculty from multiple disciplines in science and engineering.
Fall 05	Scalable Computing Systems and Applications. A new, interdisciplinary course on parallel computing systems and applications, offered under the PICASSo program, catering to students in a variety of departments, mostly in science and engineering (including computer science).
Spring 04	Computational Methods and their Use Across Scientific Disciplines. A new, interdisciplinary Graduate course offered under the PICASSo program, designed to expose students from many departments across the university to a range of computational methods, their use in real applications, and scalable parallel computing for them. Team-taught by faculty from multiple disciplines.
F'99, '02, '03	Scalable Internet Services and Infrastructure, graduate course in distributed and clustered systems and applications.
Fall 95 – 98	COS 217: Introduction to Programming Systems, sophomore course at Princeton University
Spr 95 – 98	Parallel Computer Architecture and Programming, graduate course at Princeton University
8/95	Instructor, Parallel Computer Architecture, Western Institute in Computer Science, Stanford, CA.
4/93 – 6/93	Instructor, Distributed Shared Address Space Multiprocessing, a 6-week course on scalable parallel computing (hardware and software) for advanced engineers and researchers at Silicon Graphics Inc.
4/91 – 6/91	Project Advisor and Lecturer, Stanford University. CS 315B: Parallel Programming Project. Defined and closely advised three projects that produced realistic parallel applications.
4/90 – 6/90	Teaching Assistant and Lecturer, Stanford University. CS 315B: Parallel Programming Project. Defined and closely advised projects that produced realistic parallel applications in a 10-week course.
1/90 – 1/95	Project Advisor, Stanford University. EE 391: Special Studies in Electrical Engineering. Defined and guided projects to introduce graduate students into research in parallel processing.

## COMPLETED Ph.D. DISSERTATIONS SUPERVISED

- Adrian Soviani. New Programming Models for Scalable Parallel Computing. Two Sigma, Inc.
- Erich Schmidt. Query-independent ranking for large-scale publish-subscribe systems. Google, Inc.
- Chi Zhang. A Peer-to-peer substrate for Distributed Search Trees. Google, Inc.
- Fengyun Cao. MEDYM: A distributed content-based publish-subscribe system. Goldman Sachs, Inc.
- Mao Chen. Using Explicit User Information to Improve Internet Services. IBM T.J. Watson Research Labs.
- Yefim Shuf. Improving the Memory Performance of Java Programs. Princeton University. IBM T.J. Watson Research Labs.
- Steven Kleinstein. Towards Quantitative Modeling of Immune System Dynamics. Professor at Yale University Medical School.
- Hongzhang Shan. A Comparison of Programming Models for High-Performance Parallel Computing. Los Alamos National Laboratory.
- Dongming Jiang. Performance Portability on Shared Address Space Architectures.
- Cheng Che Chen. Protein Structure Determination in the Presence of Uncertainty: Algorithms and Parallelism. With Russ Altman (Stanford Medical School).

- Angelos Bilas. Using Network Interfaces to Accelerate Software Shared Memory. University of Crete.
- Liviu Iftode. Shared Virtual Memory using Automatic Update. With Kai Li. Rutgers University (deceased).
- Steven Cameron Woo. Integrating Block Data Transfer in Cache-coherent Multiprocessors. With John Hennessy. Rambus, Inc.
- Chris Holt. Application and Architectural Bottlenecks in Distributed Shared Memory Multiprocessors. With John Hennessy. Transmeta, Inc. (deceased).
- Alexander Kozlov. Probabilistic Inference in Belief Networks: Algorithms and Parallelism. With John Hennessy and later Daphne Koller. Silicon Graphics, Inc.

Served on dissertation committees of several others.

## PROGRAM COMMITTEES

Have served on the program committees and as program chair and track chair of many ACM, IEEE and other conferences in scalable computing, including the International Symposium on Computer Architecture, Supercomputing/SC, SIGMETRICS Conf. on Measurement and Modeling of Computer Systems, Principles and Practice of Parallel Programming, Symposium on Parallel Algorithms and Architectures, International Conference on Supercomputing, International Parallel Processing Symposium, International Conference on Parallel Processing etc., as well as several ACM and IEEE workshops on scalable computing, data analysis and mining, architecture, and languages and compilers.

## INVITED EVALUATION COMMITTEES AND TALKS

Have served on several invited government research/education program and proposal evaluation committees, including for the US Government (NOAA's procurement programs and the National Science Foundation) and the Swedish Government (Evaluating the ARTES/PAMP national program for scientific research and graduate education in high-performance computing, as well as other programs for the Swedish Research Council). Have also served as an external evaluator for faculty hiring at Uppsala University, Sweden and the University of Copenhagen, Denmark.

Have delivered many invited presentations and lectures at a variety of international and domestic venues, including:

- Conference panels and invited presentations at ISCA, ASPLOS, SIAM and other conferences and workshops
- NSF and DARPA PI meetings in scalable computing and interdisciplinary research and education
- International government programs (Sweden and India, including India's cross-IIT TECHFEST)
- U.S. universities such as UC Berkeley, U. Washington, Stanford, NYU, U of Toronto, SUNY, etc.
- International universities and research laboratories/centers in France, India, Italy, Japan, Sweden, and South Africa.
- Industrial research laboratories such as Microsoft, Sun, IBM, Panasonic, Siemens etc.
- Government research laboratories such as NASA, Sandia, Argonne, PPPL (plasma physics) and GFDL (climate)
- Industrial research and product/business organizations, e.g., Yahoo, Microsoft, Endeca, etc.
- Several industrial conferences and trade shows, industrial/academic and executive summits involving web-based information access, search, dissemination/communication, and intelligence.

## PATENTS

Over ten U.S. patents filed. Following (plus some others) awarded:

Systems and Methods for Electronic Platform For Transactions of Wearable Items. United States Patent 10,796,276. Pub. Date 10/06/2020.

Systems and Methods for Electronic Platform For Transactions of Wearable Items. United States Patent 10,796,277. Pub. Date 10/06/2020.

Method and apparatus for focused crawling. United States Patent 20060277175. Pub. Date 12/07/2006.

Method and apparatus for focused crawling. United States Patent 7080073. Pub. Date 07/18/2006.

Method and apparatus for searching network resources. United States Patent 6915294. Pub. date 07/05/2005.

Method and apparatus for searching network resources. United States Patent 20050210018. Pub. date 09/22/2005

Method and apparatus for searching network resources. United States Patent 7415469. Pub. date 09/05/2006.

Method and apparatus for extracting relevant network data. United States Patent 7103838. Publication date 09/05/06.

## **SAMPLE GRANTS RECEIVED**

(Includes only grants in which I am Principal Investigator, not Co-Principal Investigator. Pending grant proposals not included.)

DeCenter founding gift. \$20 million. For research, education, and thought leadership in the decentralization of power through technology.

BlockStack Gift in cryptocurrency, 2020. A gift for research and teaching in blockchains, cryptocurrencies and their applications. Already monetized to about \$5 million.

Princeton CTO Research and Education, \$800,000, 2010.

National Institutes of Health. HHSN266200500021. 9/30/05 to 9/29/10. \$20,250,000. PI of Princeton Portion.

National Science Foundation IGERT Grant, No. DGE-9972930. 8/1/00 to 9/31/08. Funds up to fourteen graduate students per year in scalable internet services, computing and data analysis. \$2,172,000.

Accessible Climate Computing for 'Downstream' Science: An Energy and Climate Grand Challenge Proposal. Princeton Grand Challenges Program. Awarded Fall 2009. \$100,000 per year.

National Science Foundation. Presidential Early Career Award for Scientists and Engineers (PECASE). Only computer scientist to receive it that year. 3/1/97 to 2/28/05. \$500,000.

National Science Foundation. CISE Research Award. 9/15/98 to 8/31/03. \$980,000.

National Science Foundation. CISE Instrumentation Award. Three projects in applications and scalable computing. \$2,172,000.

National Science Foundation. Adaptive Performance Portable Software for Next-Generation Applications. 9/15/99 to 8/31/03. \$600,000.

firstRain, Inc. Collaborative Student Research Grant. 9/1/00 to 6/30/01.

National Oceanic and Atmospheric Administration. 7/1/04 to 9/30/07. \$120,000.

Alfred P. Sloan Foundation. Sloan Research Fellowship. 9/1/98 to 9/15/2000. \$35,000.

## **PROFESSIONAL ORGANIZATIONS**

The Association for Computing Machinery

Institute of Electrical and Electronics Engineers, Inc.

Phi Beta Kappa, Tau Beta Pi, Sigma Xi

## **PUBLICATIONS**

A leading graduate/practitioner level textbook (below) and over 100 refereed conference and journal publications.

### **Textbook**

David E. Culler, Jaswinder Pal Singh. *Parallel Computer Architecture: A Hardware-Software Approach*. With Anoop Gupta. Morgan Kaufmann Publishers, 1998. Leading textbook in parallel architecture and programming.

### **SELECT RECENT PUBLICATIONS**

Shuf, Y., Gupta, M., Franke, H., Appel, A. W. & Singh, J. P., *Creating and Preserving Locality of Java Applications at Allocation and Garbage Collection Times*, 37 ACM SIGPLAN Notices 13 (2012)

Soviani, A. & Singh, J. P., *Estimating Application Hierarchical Bandwidth Requirements Using BSP Family Models* (2012), presented at the IEEE 26th International Parallel and Distributed Processing Symposium Workshops (2012)

Soviani, A. & Singh, J. P., *Optimizing Communication Scheduling Using Dataflow Semantics*, presented at the 38th International Conference on Parallel Processing (2009)